

**GENTNER - a miniaturised LIBS/Raman
instrument for the comprehensive *in-situ* analysis
*of the Martian surface***

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and the GENTNER Team*

EXOMARS: search of life on Mars

Flagship mission of European exploration of Mars

- Lander with analytical payload (PASTEUR)

Search for direct evidence of life

- Organic matter
- Biomineralisation

Identification of chemical trends and mineral phases

- Carbonates, Magnetite as indicators of biological activity

Present situation

Alpha particle X-Ray Spectrometer (APXS)

Mössbauer spectrometer

Adapted to space

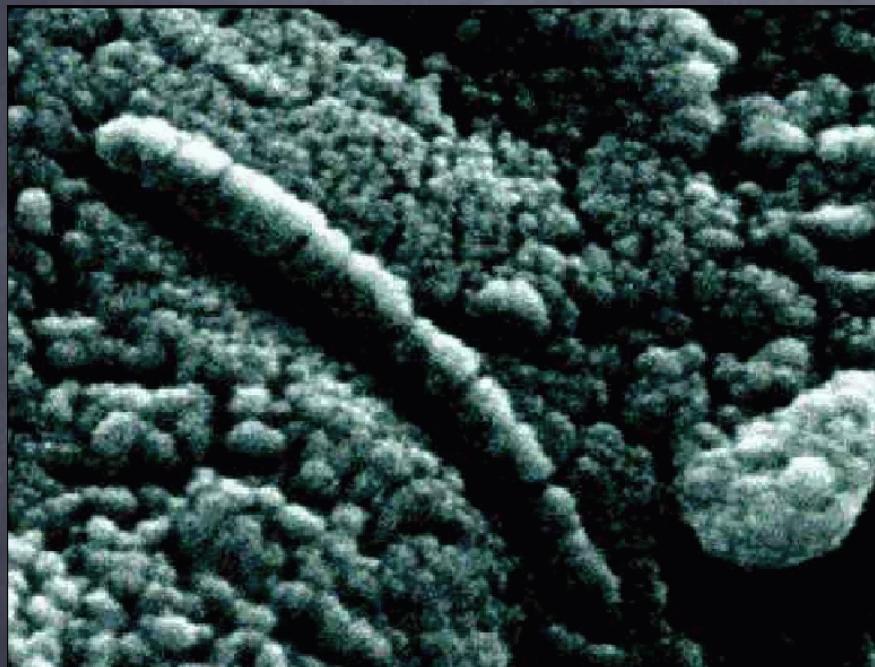
Clear physical interpretation

BUT...

4 - 8 hours/spectrum

4 cm diameter analytical area

High resolution is needed!



ALH84001



Silica-witherite biomorph

J. M. GARCÍA RUIZ *et al.*: *Morphology: An Ambiguous Indicator of Biogenicity*,
Astrobiology, 2(3), 353-369 (2002)

GENTNER

Integrated Raman/Laser-Induced Breakdown Spectrometer for submillimeter-scale measurements

Named by Wolfgang Gentner (1906 - 1980)

Father of nuclear methods application in planetary science

Raman: Shift of a laser beam central frequency of the amount related to the energy of molecular vibrations ⇒ **molecular analysis**

LIBS: Emission of atomic lines by the plasma generated by a laser shot during photoablation ⇒ **elemental analysis**

Why GENTNER

Fast in-situ determination of elemental concentration (~100ppm) with high spatial resolution (~100 μm)

No sample preparation needed

No interferences from dust layers

Elemental depth profiling

Mineral composition

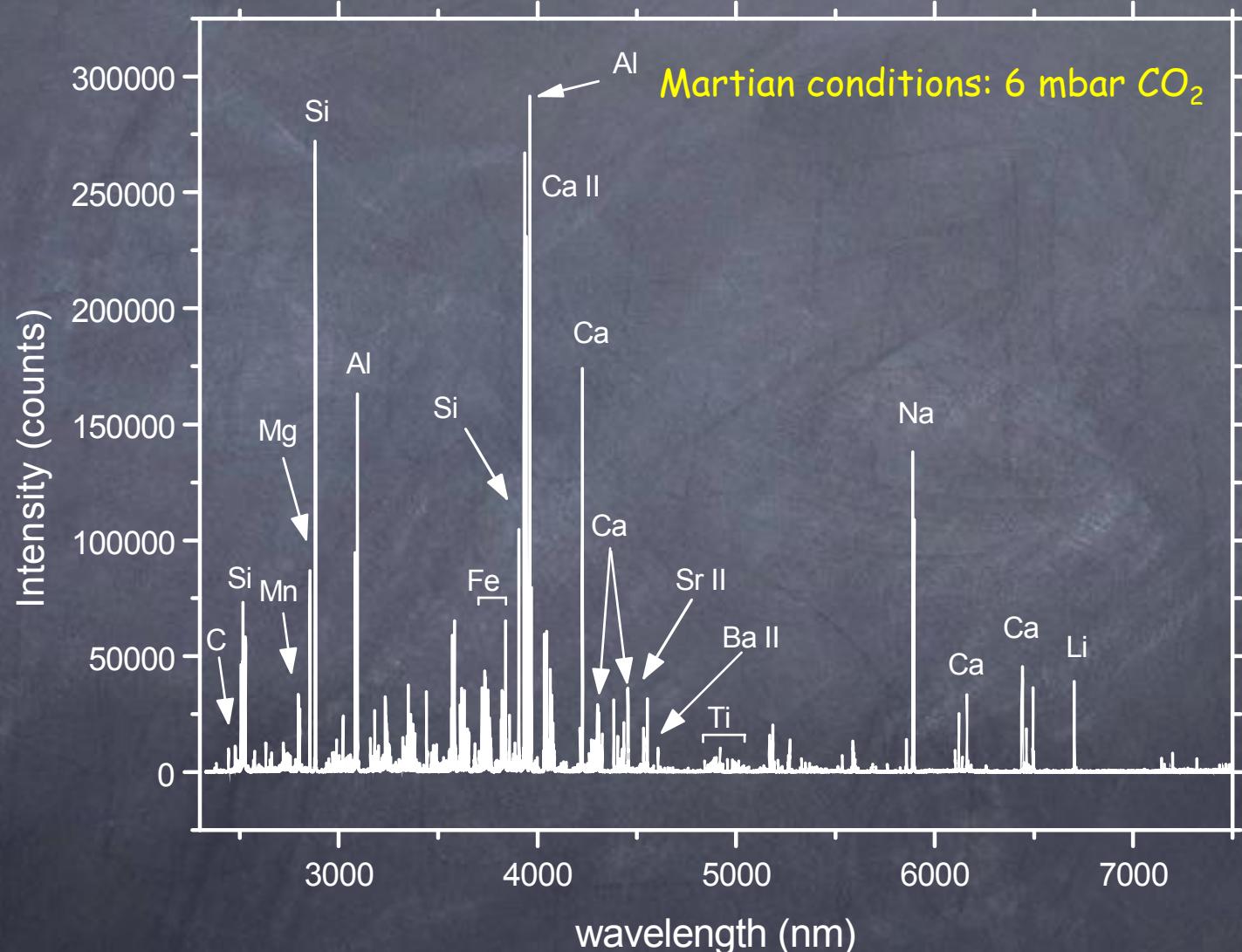
Analysis of organics

Can be coupled with other techniques (chemical microchips, chromatography...)

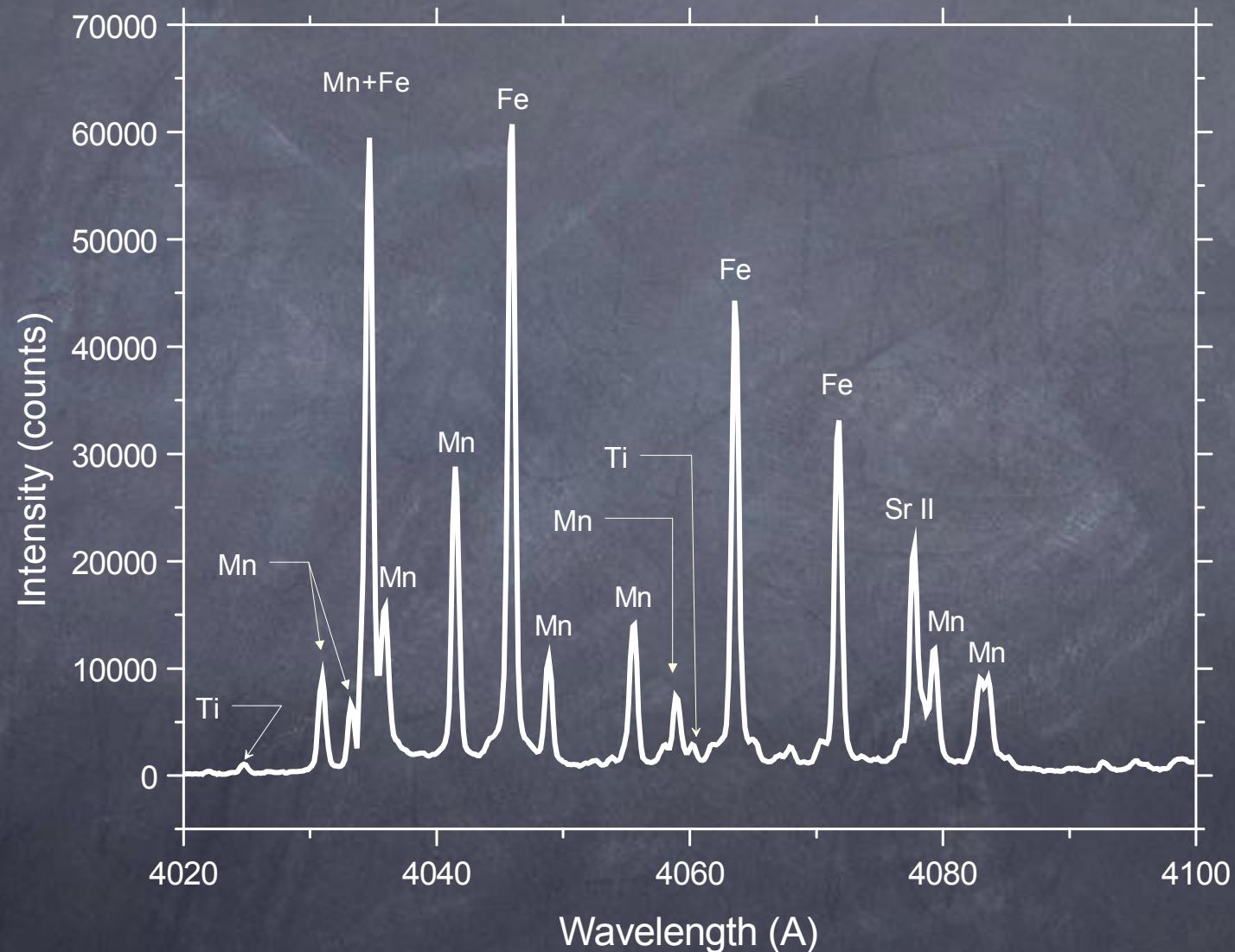
Specific applications of GENTNER

| | | |
|---------------------|---|--|
| Exobiology | Signatures of organics | Molecular structures Characterisation of biofilm Extint or extant life |
| Organic chemistry | Life-essential elements identification Reaction with specific reagents | Presence and analysis of organic matter |
| Atmospheric science | Adsorbed neutrals, ions and radicals on Martian crust grains | Hazards for human exploration |
| Mineralogy | Bio-mineralisation | Mineral phases Grain size distribution Viscosity |
| Geochemistry | Bulk chemical composition | Abundance of elements Geologic and geochemical history Depth profiling Surface/bulk materials |

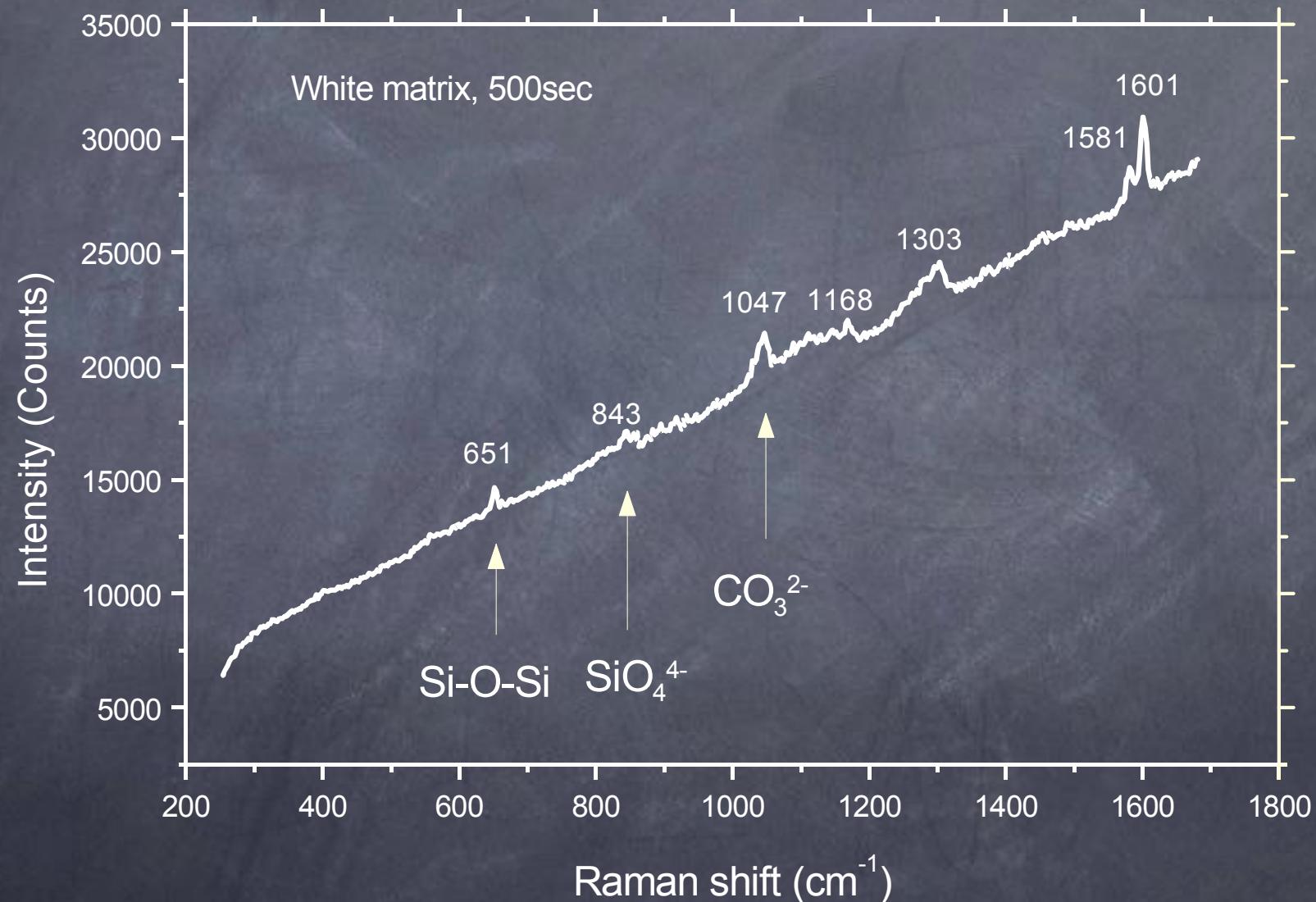
Andesite LIBS spectrum



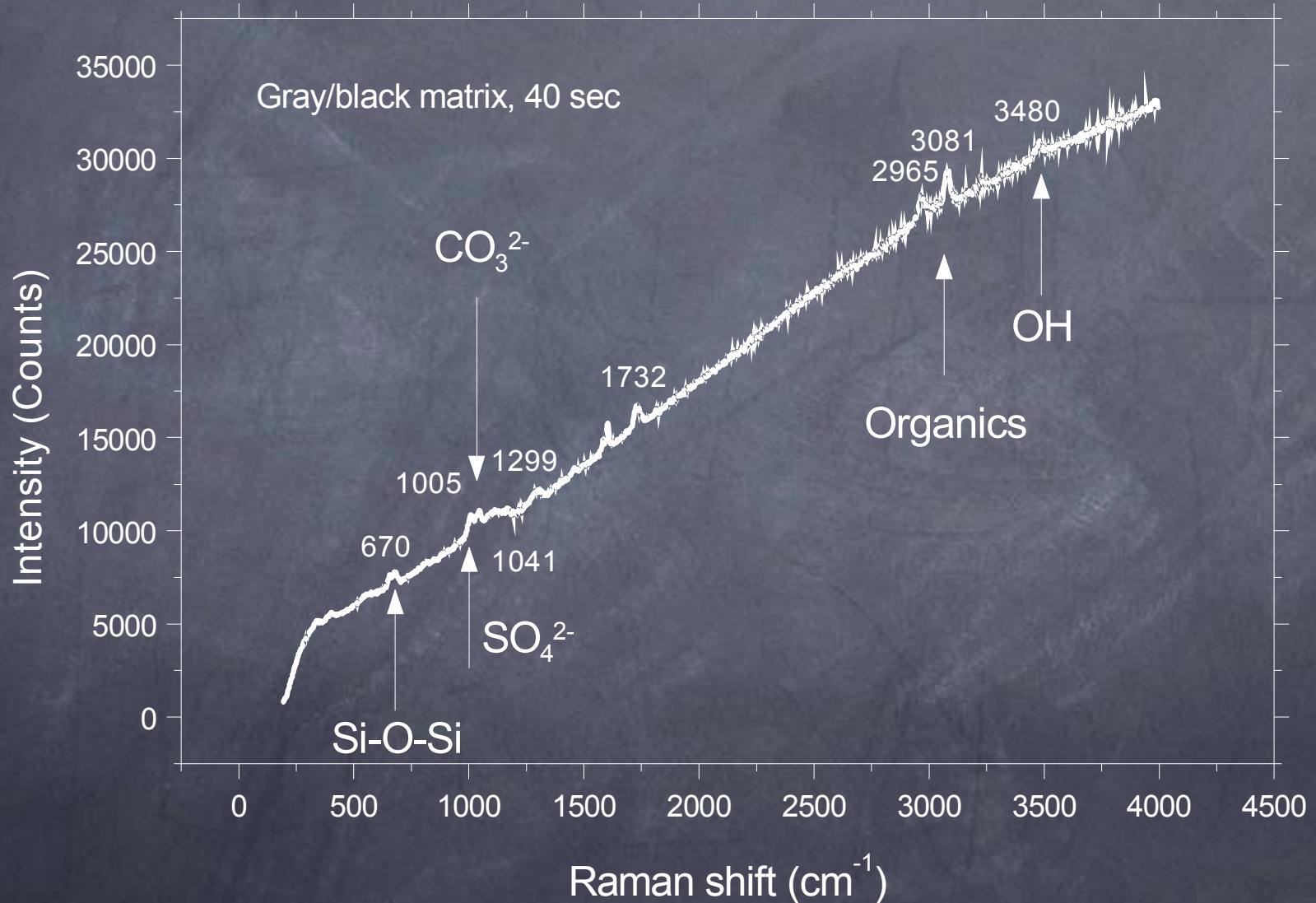
Andesite LIBS spectrum cont'd



Raman spectra: ALH84001



Raman spectra: ALH84001



Heritage

First PASTEUR industrial study:
Integrated MIcroscope RAman
spectrometer (MIRA)

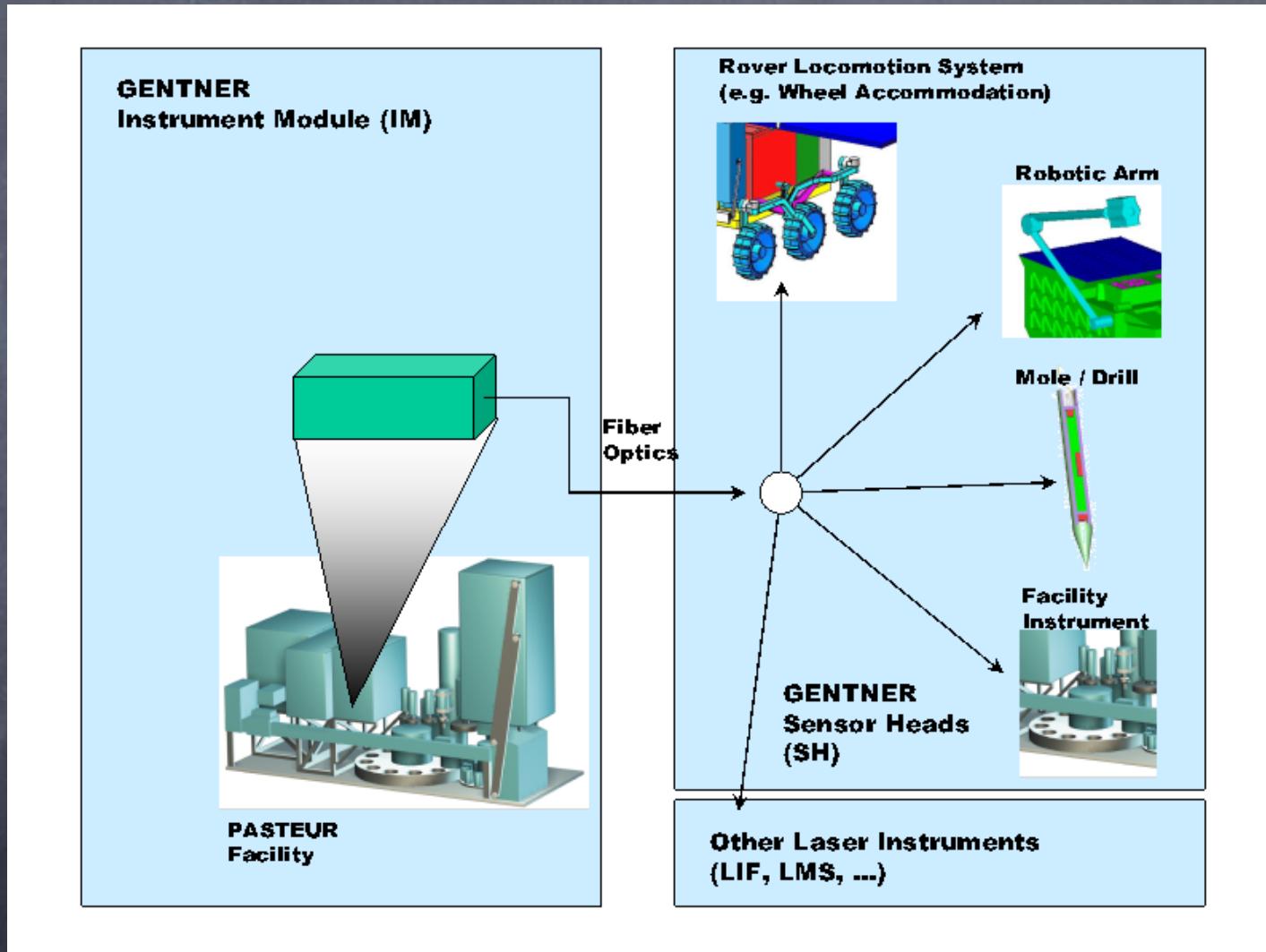
Laser Plasma Spectrometry for
Planetary Exploration (LPSPE)

The diagram illustrates the evolution of spectrometry through three stages: MIRA, LIRAMIS, and GENTNER. It begins with the text "First PASTEUR industrial study: Integrated MIcroscope RAman spectrometer (MIRA)" on the left. An arrow points down to the text "LIPS/Raman for In-Situ Science (LIRAMIS)". A second arrow points down to the word "GENTNER" at the bottom. This visual flow represents the progression from an industrial study to planetary exploration and finally to a specific instrument name.

LIPS/Raman for In-Situ Science
(LIRAMIS)

GENTNER

Concept

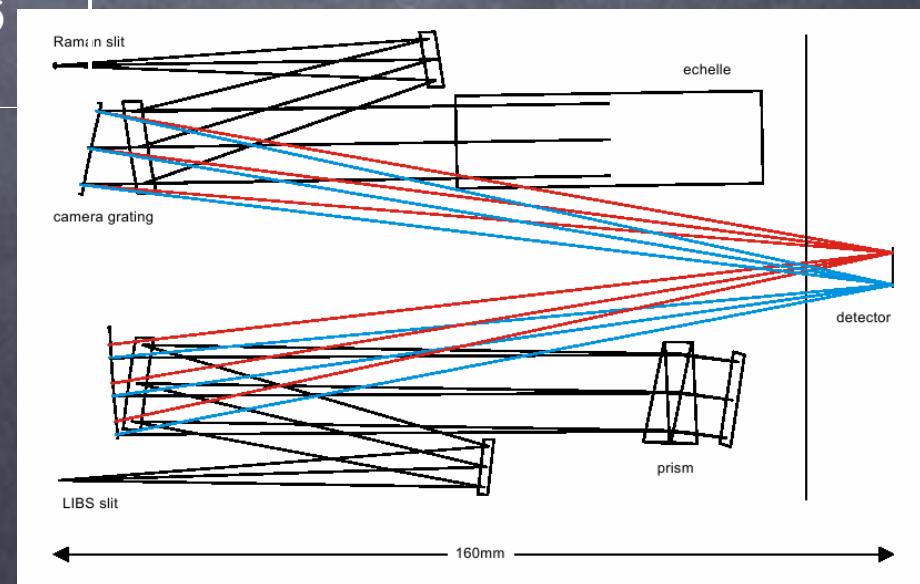


Sources

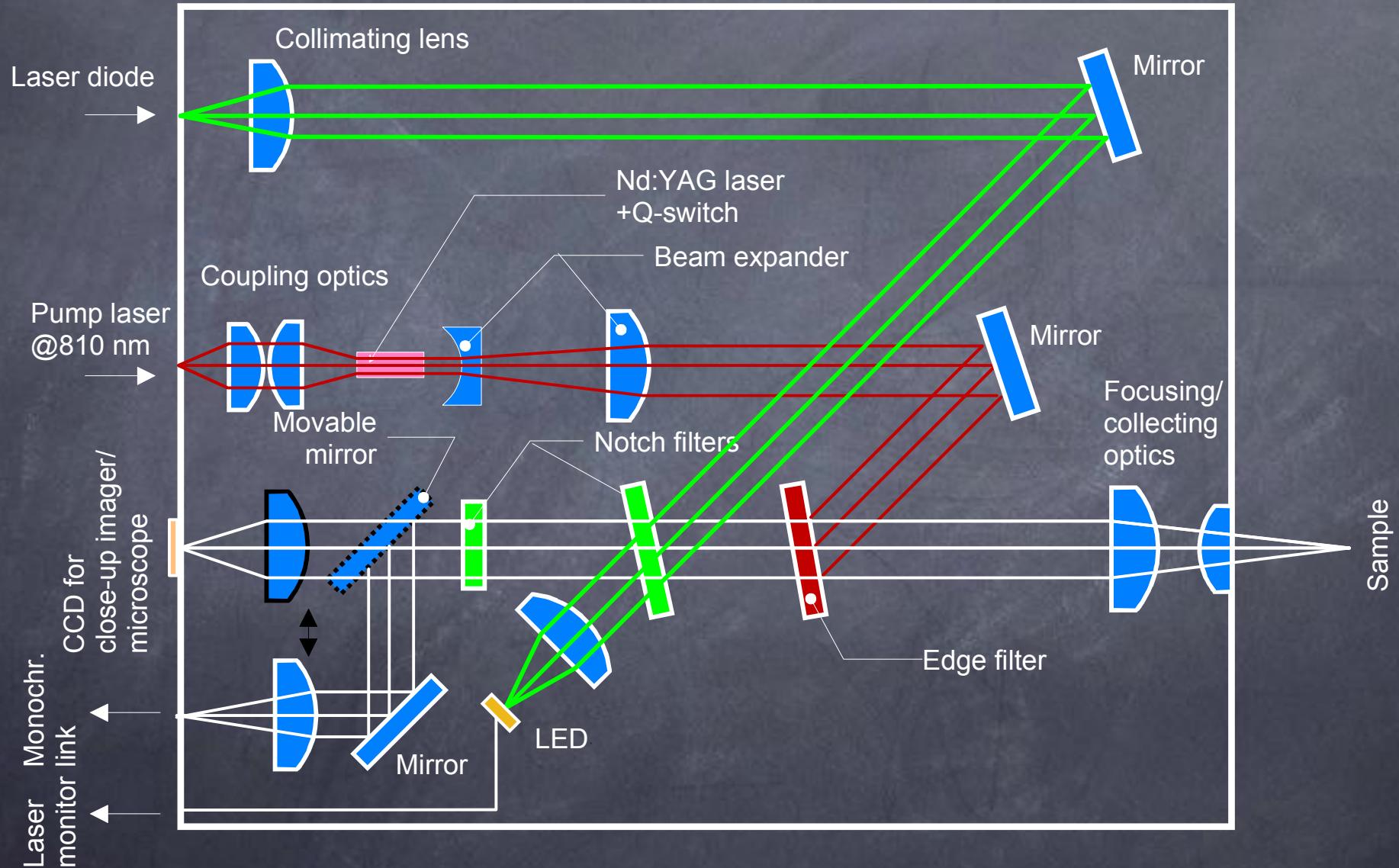
| | <i>LIBS</i> | <i>Raman</i> |
|----------------------|-------------------------|----------------------|
| Operation mode | Pulsed | CW |
| Wavelength | 1064 nm | 600 - 700 nm |
| Wavelength stability | Uncritical | < 0.2nm |
| Sample irradiance | >500 MW/cm ² | <1KW/cm ² |
| Spot size | 50 - 100 μm | 20 - 50 μm |

Spectrometer

| <i>Parameter</i> | <i>Raman</i> | <i>LIBS</i> |
|----------------------------------|--|--|
| Echelle grating | RGL 413 E 27 grooves/mm, 70° blaze angle | RGL 407 E 46.1 grooves/mm, 32° blaze angle |
| Order | 20 | 92 |
| Slit size | 200x200μm | 40x40μm |
| f/# | f/10 | f/10 |
| Spectral resolution per 3 pixels | 25pm@200nm, 125pm@1000nm | 0.20nm@720nm, 0.25nm@900nm |
| Detector | EMCCD DV885 1002x1004 | EMCCD DV885 1002x1004 |



Sensor head



Budgets

| Mass | | Thermal power dissipation | |
|----------------------------|-------|----------------------------------|-----------|
| Instrument module mass | 1245g | LIBS spectrum acquisition | 5,3W |
| Sensor head mass | 209g | Raman spectrum acquisition | 7W |
| Power absorption | | Data transfer | 4,1W |
| LIBS spectrum acquisition | 6.8W | Idle mode | 2,4W |
| Raman spectrum acquisition | 7.2W | Data amount | |
| Data transfer | 4.3W | LIBS spectrum | 158 kByte |
| Idle mode | 2.5W | Raman spectrum | 52.5kByte |
| | | Housekeeping | 200Byte |

The GENTNER Team

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